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Dilated cardiomyopathy (DCM) is defined as primary myocardial disease characterized by weakened pump function, ventricular dilation and hypertrophy (dilatation + hypertrophy = eccentric hypertrophy). It is important to realize that a multitude of events can cause myocardial damage with the end result of a dilated hypocontractile right or left ventricle, and the term DCM should be reserved for those cases where no underlying cause for this phenotype is recognizalbe. Essentially any disease that either causes volume overload or negatively affects systolic function may look like DCM. Myocardial damage may toxic, drug induced, metabolic, infectious and immune-mediated. In dogs an established cause of myocarditis is Trypanosoma cruzi (Chagas disease), possible other infections are Leptospirosis, Toxplasmosis, Neosporidiosis, Borreliosis, Parvoviroris and unidentified other viruses.[1] In humans, according to the American Heart Association, cardiomyopathies are classified as primary congenital, primary mixed (congenital and acquired), and secondary cardiomyopathies.[2]

Tables 1 and 2 summarize the classification of cardiomyopathies in dogs modified from the AHA classification, table 3 contains those diseases that may look like DCM.

Canine Cardiomyopathies (CMs) modified from the AHA classification[1]

Table 1: Primary* (congenital and mixed°) CMs
Dilated CM
Arrhythmogenic Right Ventricular CM
Tachycardia-induced CM
Myocarditis
Hypertrophic CM
Restrictive CM
Mitochondrial myopathies

* primary CM = only or mainly involving the cardiac muscle
° mixed CM = partially congenital and partially acquired

Table 2: Secondary§ cardiomyopathies
Infiltrative neoplastic, lymphoma
Toxic / drug-induced, e.g. doxorubicine
Septic / endotoxic
Endocrine, e.g. hypothyroidism
Nutritional, e.g. Taurine, Carnitine, starvation
Muscular dystrophies

§ secondary = myocardium involved as part of multisystemic dz

Table 3: Canine CMs looking like DCM
(Idiopathic) DCM
Tachycardia-induced
± arrhythmogenic
Toxic, doxorubicine-induced
Septic, endotoxic
Myocarditis
Endocrine, hypothyroidism
Nutritional
End-stage HCM

Most of the diseases in the tables may be reversible or at least may not be progressive, when the underlying cause is eliminated. This is particularly true for tachycardia-induced DCM; it is very important to realize that the tachycardia may only be present intermittently and not necessarily during physical examination.

HCM is not an important disease in dogs, as opposed to cats where this is the most commonly diagnosed myocardial disease. In contrast, DCM is very rare in cats, however, as indicated in table 3, the end-stage of HCM may look like DCM. This presentation of HCM mimicking DCM has also been termed burn-out HCM.[3]

Besides the above tabulated disease there are many canine Non-CM heart diseases that may also look like DCM. As indicated above, any disease that results in volume overload may end in myocardial failure, if the volume overload cannot be compensated by the affected ventricle. Common congenital diseases causing left ventricular (LV) volume overload include patent ductus arteriosus Botalli, ventricular septal defect and mitral valve dysplasia. The most important acquired disease causing LV volume overload is mitral valve endocardiosis. Common congenital disease causing right ventricular (RV) volume overload include atrial septal defect, ventricular septal defect and tricuspid valve dysplasia.

Similar to burn-out cardiomyopathy, any disease causing severe pressure overload that initially induces concentric hypertrophy may in the end stage result in myocardial failure and have a phenotype similar to DCM. Congenital or acquired diseases include subaortic stenosis and systemic hypertension affecting the LV, and pulmonic stenosis or pulmonary hypertension affecting the RV.

Finally, an athletic heart may present on echocardiography as dilated hypocontractile LV; however, such a dog should not show any signs of heart failure, and very simple the heart rate should be remarkably low. This physiological state should not be confounded with myocardial

disease. Nevertheless, in the extreme case it seems possible that an athletic heart turns into a diseased DCM-like heart.

In view of all these possible causes of a dilated and / or hypocontractile left or right ventricle, DCM is defined as *"a primary myocardial disease of unknown cause that mainly affects large breed dogs of some specific breeds, the primary problem being decreased contractility resulting in a decreased cardiac stroke volume with compensatory (left) ventricular dilation and eccentric hypertrophy"*.

Further consequences in the sequence of events are an increased diastolic filling pressure which will result in increased (left) atrial pressure. The ensuing (left) atrial dilation / stretch will elicit atrial arrhythmias, often atrial fibrillation. The increased ventricular myocardial wall tension results in myocardial ischemia, which may elicit ventricular arrhythmias. Around ½ of dogs with DCM have supraventricular arrhythmias, mainly A Fib, and around ¼ have ventricular arrhythmias.
From a clinical / symptomatic standpoint, the hypocontractility (systolic function) will result in a low cardiac output which manifests as forward failure. Tachyarrhythmias also will result in low cardiac output and forward failure. The increased diastolic filling pressure will result in congestion, i.e. backward failure. The associated physical findings are:

- cardiogenic shock (weakness, pale mucous membranes, weak pulse)
- dyspnea by pulmonary edema or pleural effusion
- ascites
- arrhythmias
- murmur of mitral regurgitation (anulus dilation)

If a dog is presented with such clinical abnormalities, the diagnostic cardiac work-up will include thoracic radiographs, ECG and echocardiography. If on echo a dilated and / or hypocontractile ventricle is found, based on the above, the thought process must include all possible disease known to cause volume or pressure overload. Only if all mentioned diseases are excluded, (idiopathic) DCM may be the correct diagnosis.

References:

[1]Sisson D., O'Grady M., Calvert C. Myocardial diseases of the dog. In Fox, Sisson, Moise (eds.) Textbook of Canine and Feline Cardiology. 2nd ed. 1999, pp 581-619.

[2]Maron B.J. et al. Contemporary Definitions and Classification of the Cardiomyopathies:.an American Heart Association Scientific Statement from the Council on Clinical Cardiology, Heart Failure and Transplantation Committee; Quality of Care and Outcomes Research and Functional Genomics and Translational Biology Interdisciplinary Working Groups; and Council on Epidemiology and Prevention. Circ. 2006, 113: 1807-1816.

[3]Biagini E. et al. Dilated-hypokinetic evolution of hypertrophic cardiomyopathy: prevalence, incidence, risk factors, and prognostic implications in pediatric and adult patients. J. Am. Coll. Cardiol. 2005, 46: 1543-1550.